

Claims

I claim:

1. A method of making emulsans which comprises culturing a microorganism capable of producing emulsans in an effective emulsan producing culture medium wherein the culture medium contains fluorinated compounds that are assimilated by the microorganism and incorporated into the emulsan molecule elaborated by the microorganism.
2. The method of claim 1 wherein the microorganism is a bacteria.
3. The method of claim 2 wherein the bacteria is an *Acinetobacter*.
4. The method of claim 2 wherein the bacteria is *Acinetobacter calcoaceticus* RAG1.
5. The method of claim 4 wherein the fluorinated compounds are fluorinated fatty acids.
6. The method of claim 5 wherein the fluorinated fatty acids are 2-poly(perfluoropropanoxy)-methylperfluoropropanoate; 2-[(carboxydifluoromethoxy)-poly(perfluoromethoxy)]-poly(perfluoroethanol)-difluoroacetic acid; or a mixture of both.
7. The method of claim 6 wherein the fluorinated fatty acid is 2-poly(perfluoropropanoxy)-methylperfluoropropanoate.
8. The method of claim 6 wherein the fluorinated fatty acid is 2-[(carboxydifluoromethoxy)-poly(perfluoromethoxy)]-poly(perfluoroethanol)-difluoroacetic acid.

9. A method of making fluorinated emulsans which comprises culturing an emulsan producing organism in the presence of fluorinated compounds that are assimilated by the microorganism and incorporated into the emulsan molecule elaborated by the organism.

10. The method of claim 9 wherein the emulsan producing organism is of the genus *Acinetobacter*.

11. The method of claim 9 wherein the organism is *Acinetobacter calcoaceticus* RAG1.

12. The method of claim 11 wherein the fluorinated compounds are fluorinated fatty acids are 2-poly(perfluoropropanoxy)-methylperfluoropropanoate; 2-[(carboxydifluoromethoxy)-poly(perfluoromethoxy)]-poly(perfluoroethanol)-difluoroacetic acid; or a mixture of both.

13. In a method of making emulsans by culturing an emulsan producing microorganism in a culture medium under conditions sufficient to produce emulsans, the improvement which comprises:
adding one or more fluorinated compounds to the culture medium whereby the fluorinated compounds are assimilated by the microorganism and incorporated into the emulsan molecule resulting in fluorinated emulsans.

14. The improved method of claim 13 wherein the fluorinated compound is 2-[(carboxydifluoromethoxy)-poly(perfluoromethoxy)]-poly(perfluoroethanol)-difluoroacetic acid.

15. The improved method of claim 13 wherein the fluorinated compound is 2-poly(perfluoropropanoxy)-methylperfluoropropanoate.

16. A fluorinated emulsan polymer made by a process which comprises fermenting a microorganism capable of producing emulsans in an effective emulsan producing culture medium wherein the culture medium contains fluorinated compounds that are assimilated by the microorganism and incorporated into the emulsan molecule elaborated by the microorganism.

17. A polysaccharide backbone fluorinated emulsan polymer made by a process which comprises fermenting *Actinobacter calcoaceticus* RAG1 in an effective emulsan producing culture medium wherein the culture medium contains one or more fluorinated carboxylic acid compounds or esters thereof that are assimilated by the microorganism and incorporated into the emulsan molecule made by the microorganism whereby the fluorinated carboxylic acid or fluorinated carboxylic acid ester is attached to the polysaccharide backbone of the emulsan.

18. The polysaccharide of claim 17 wherein the fluorinated carboxylic acid is 2-[(carboxydifluoromethoxy)-poly(perfluoromethoxy)]-poly(perfluoroethanol)-difluoroacetic acid.

19. The polysaccharide of Claim 17 wherein the fluorinated carboxylic acid is 2-poly(perfluoropropanoxy)-methylperfluoropropanoate.

20. An isolated fluorinated emulsan containing a polysaccharide backbone produced by the fermentation of *Actinobacter calcoaceticus* RAG1 in the presence of one or more fluorinated carboxylic acid compounds or fluorinated carboxylic acid ester compounds whereby said fluorinated compounds are attached to the polysaccharide backbone of the emulsan.

21. The emulsan of claim 20 wherein the fluorinated carboxylic acid is 2-[(carboxydifluoromethoxy)-poly(perfluoromethoxy)]-poly(perfluoroethanol)-difluoroacetic acid.

22. The emulsan of claim 20 wherein the fluorinated carboxylic acid is 2-poly(perfluoropropanoxy)-methylperfluoropropanoate.

23. A method of making emulsans which comprises culturing a microorganism capable of producing emulsans in an effective emulsan producing culture medium wherein the culture medium contains as the carbon source (a) a lower alcohol and (b) fluorinated compounds that are assimilated by the microorganism and incorporated into the emulsan molecule elaborated by the microorganism.

24. The method of claim 23 wherein the fluorinated carboxylic acid is 2-[(carboxydifluoromethoxy)-poly(perfluoromethoxy)]-poly(perfluoroethanol)-difluoroacetic acid.

25. The method of claim 23 wherein the fluorinated carboxylic acid is 2-poly(perfluoropropanoxy)-methylperfluoropropanoate.

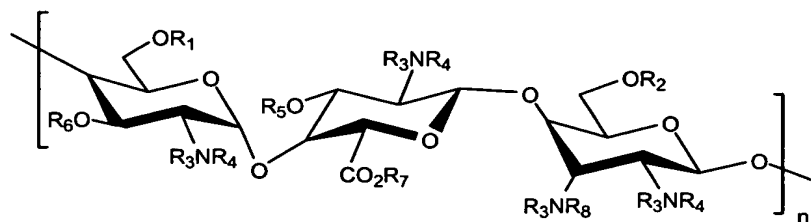
26. In a method of making emulsans by culturing an emulsan producing microorganism in a culture medium containing a carbon source under conditions sufficient to produce emulsans, the improvement which comprises employing as the carbon source:

- a. a lower alcohol and
- b. one or more fluorinated compounds whereby the fluorinated compounds are assimilated by the microorganism and incorporated into the emulsan molecule resulting in fluorinated emulsans.

27. The improved method of claim 26 wherein the fluorinated compound is 2-[(carboxydifluoromethoxy)-poly(perfluoromethoxy)]-poly(perfluoroethanol)-difluoroacetic acid.

28. The improved method of claim 26 wherein the fluorinated compound is 2-poly(perfluoropropanoxy)-methylperfluoropropanoate.

29. An emulsan compound of the formula



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wherein

$R_1 = \text{H, acyl, X, Z}$; $R_2 = \text{H, acyl, X, Z}$; $R_3 = \text{H, COCH}_3, \text{X}$; $R_4 = \text{H, X, COX, CH}_2\text{X, CH}_2\text{NHX Z}$; $R_5 = \text{H, X}$; $R_6 = \text{H, X}$; $R_7 = \text{H, X, COCH}_3, \text{COX, Z}$

$\text{X} = \text{haloalkyl, haloaryl, haloacyl, perhaloalkyl, perhaloaryl, perhaloacyl, perhalopolymer fluoroalkyl, fluoroaryl, fluoroacyl, perfluoroalkyl, perfluoroaryl, perfluoroacyl, perfluoropolymer, F, Cl, Br, I, CF}_3, \text{CCl}_3, \text{COC}_x\text{F}_y, \text{CH}_2\text{Br, CH}_2\text{I, C}_x\text{F}_y\text{H}_z, \text{COCH}_2(\text{C}_x\text{H}_{3-y}\text{Br}_y), \text{COCH}_2(\text{C}_x\text{H}_{3-y}\text{Cl}_y), \text{COCH}_2(\text{C}_x\text{H}_{3-y}\text{I}_y), \text{C}_x\text{F}_y\text{H}_z, ([\text{CH}_2]_m\text{O})_x(\text{CH}_2\text{CF}_2\text{O})_y(\text{CF}_2\text{CF}_2\text{O})_z(\text{CF}_2)_2\text{CF}_2\text{CH}_2\text{O}(\text{CH}_2)_p\text{OH, CH}_2\text{C}(\text{OH})\text{C}_x\text{F}_y\text{H}_z, \text{C}_x\text{F}_y\text{H}_z\text{O}_p, \text{COC}_x\text{F}_y\text{H}_z, \text{OCH}_2\text{C}_x\text{F}_z[\text{C}_x\text{F}_z\text{O}]_m\text{F, CH}_2\text{C}(\text{CH}_3)\text{CO}_2\text{C}_x\text{H}_z(\text{CF}_2)_m\text{CF}_3, \text{CH}_2(\text{CF}_2\text{O})_x(\text{CF}_2\text{CF}_2\text{O})_y(\text{CF}_2\text{O})_z\text{CF}_2\text{CH}_2\text{OH, COCF}(\text{CF}_3)-[\text{CF}(\text{CF}_3)\text{CF}_2\text{O}]_m\text{F, NHC}_x\text{F}_y\text{H}_z\text{O}_p, \text{CH}_2\text{CF}_2\text{O}[\text{CF}_2\text{CF}_2\text{O}]_m(\text{CF}_2\text{OCF}_2\text{CH}_2\text{OH, COC}_x\text{H}_z(\text{CF}_2)_m\text{CF}_3, \text{COCF}_2\text{O}[\text{CF}_2\text{CF}_2\text{O}]_n\text{CF}_2\text{OCF}_2\text{CO}_2\text{H, } ([\text{CH}_2]_m\text{O})_x(\text{CH}_2\text{CF}_2\text{O})_y(\text{CF}_2\text{CF}_2\text{O})_z\text{CF}_2\text{CH}_2\text{O}(\text{CH}_2)_p\text{OH, N}[\text{C}_x\text{F}_y\text{H}_z]_p, \text{C}_x\text{H}_z\text{CO}_2\text{C}_x\text{H}_z(\text{CF}_2)_m\text{CF}_3, \text{COC}_x\text{F}_y[\text{C}_p\text{F}_z\text{O}]_m\text{F, a luminescent residue, a fluorescent residue, a halogenated luminescent residue or a halogenated fluorescent residue and } m, x, p, y \text{ and } z \text{ are integers from 1 to 150.}$

30. The emulsan compound of claim 29 wherein m is from 10 to 100 inclusive; x, p, y, z are from 10 to 75 inclusive; acyl and alkyl residues are lipophilic moieties, selected from the group consisting of saturated and unsaturated aliphatic residues with C_k chains wherein k is from 2 to 100 inclusive; and aryl residues are aromatic moieties selected from the group consisting of benzyl, biphenyl, phenyl polycyclic aromatics, and heteroatom-containing aromatics.

31. The emulsan compound of claim 30 wherein m is from 10 to 50 inclusive; x, p, y, z are from 10 to 75 inclusive; and k is from 2 to 50 inclusive.

32. The emulsan compound of claim 31 wherein x, p, y, z are from 10 to 50 inclusive and k is from 2 to 20 inclusive.